Demanding class spurs student to Stanford

After taking a molecular biology course at VCU, Nick Rodriguez is working on a Ph.D. in biomedical informatics at Stanford University

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Hearing that Nick Rodriguez goes to Stanford, you probably wouldn't guess that he had dropped out of high school and didn't get the best grades as an undergrad at VCU.

"It's OK to have a nontraditional background," Rodriguez said. "I dropped out of high school and worked in food service for years before I decided to go back to school. My grades weren't stellar, but my passion for learning and science kept me on a good path."

‘The objective of this course isn’t to increase your knowledge but rather to expand your ignorance.’

Jacob Jaminet and Nick Rodriguez at Hoover Tower at Stanford University.

Rodriguez graduated from VCU last spring with a degree in bioinformatics. He is pursuing a Ph.D. in biomedical informatics at Stanford University. He says his interest in biomedical research started as a result of the VCU course Molecular Biology Through Discovery – BNFO 300.

Jeff Elhai teaches that course, which has filled many VCU students with dread. With his long, curly gray hair and calm demeanor, Elhai reminds some students of Einstein. A placard outside his office proudly reads, “Jeff Elhai, ‘Doctor Free Zone.’”

“The objective of this course isn’t to increase your knowledge but rather to expand your ignorance. After all, the process of science occurs at the boundary of what is known, which, as it grows, generates a greater interface with what is not known,” the course website declares.

Over the course of the semester, students are charged with finding a mentor and pitching a single experiment to expand the realm of existing biological knowledge. While working with their mentor, students follow in the footsteps of the pioneers of biology. They read the papers of James Watson and Francis Crick, examine original research results and learn to “think like a scientist.”

Through this process, Nick Rodriguez learned that he was interested in molecular mechanisms as they relate to human disease. He started looking for opportunities to study this which brought him to the lab of Dr. Barbara Boyan, dean of the School of Engineering at VCU. The Boyan lab focuses on bones and cartilage growth and synthesis.

Bones form when cartilage goes through the process of calcification. Small membrane-bound vesicles in the extracellular matrix are

The matrix vesicles serve as a ‘hub for calcification.’ But researchers believe that the vesicles might be involved in other processes as well.

View of Stanford University from Hoover Tower.

an important part of this process. The matrix vesicles contain biochemicals that serve as a “hub for calcification.” Enzymes in the vesicles promote calcium phosphate formation.

Matrix vesicles are also found in areas of the cartilage that are not mineralized, such as the growth plate resting zone and articular cartilage. Researchers have found that matrix vesicles might be involved in processes other than calcification.

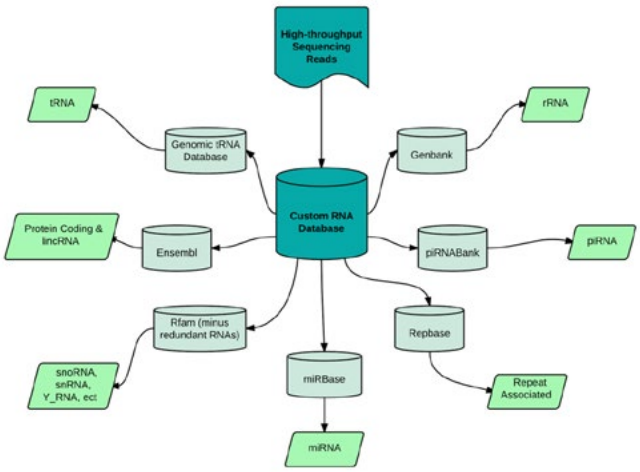
The Boyan lab analyzed the contents of the matrix vesicles and found that they were packed with higher levels of certain microRNAs than the cytoplasm, the jellylike material that makes up much of a cell inside the cell membrane.

RNA is a biomolecule that performs various functions in the cell. One form of RNA called messenger RNA – mRNA – carries the information encoded in the DNA to the ribosome, where it is translated into protein, a process called transformation. During transformation, transfer RNAs – tRNAs – carry the amino acids to the ribosome and link the amino acids together forming a protein.

MicroRNA, also called miRNA, is produced in the nucleus of the cell and transported out into the cytoplasm. There, miRNA binds to a protein and acts like one side of Velcro. The miRNA lodged in the protein selectively binds to mRNA in the cytoplasm. This protein-miRNA complex then cuts the mRNA so it is unable to be translated into protein.

The Boyan group discovered that three microRNAs – miR-122-5p, miR-223-3p and miR-451-5p – were concentrated in the matrix vesicles. These microRNAs do a variety of functions that regulate cartilage, bone growth and diseases like osteoarthritis. The regulation

Jeff Elhai, the instructor for Molecular Biology through Discovery. His course does not focus on filling your head with knowledge but rather expanding your ignorance.



The layout of the bioinformatics pipeline that Rodriguez was responsible for the Boyan lab project. This pipeline sorted out the raw sequences that were collected from the biological experiments and classified them into their functional groups.

networks affects when and where cartilage turns into bone. The matrix vesicles containing these miRNA could be transferred between cells and change the cell metabolism

That research provided inspiration for Nick Rodriguez. He spent long hours in the Boyan lab, including a summer on a life science grant. Through his time in the lab, Rodriguez determined that research was the career he wanted to pursue. He applied to graduate schools across the nation and accepted the offer to go to Stanford.

“Stanford is magically beautiful both academically and physically,” Rodriguez said. At Stanford, he is currently rotating in a lab that uses statistical and machine learning methods to characterize different forms of autism based on clinical and genomic data.

For VCU students who also may aspire to do graduate work at one of the world’s best universities, Rodriguez has some advice.

“Work hard at the things you love,” he recommends. “Make it real.” •